

REMARKS/ARGUMENTS

Reconsideration of the application is requested.

Claims 1-13 remain in the application.

In item 3 on pages 2-4 of the above-mentioned Office action, claims 1, 6, 9, and 11 have been rejected as being unpatentable over Nelson (US Pat. No. 4,930,216) in view of Beene et al. (US Pat. No. 5,673,478) under 35 U.S.C. § 103(a).

In item 4 on pages 4-5 of the above-mentioned Office action, claims 2 and 3 have been rejected as being unpatentable over Nelson in view of Beene et al. and further in view of Haraichi et al. (US Pat. No. 5,055,696) under 35 U.S.C. § 103(a).

In item 5 on page 5 of the above-mentioned Office action, claim 4 has been rejected as being unpatentable over Nelson in view of Beene et al. and further in view of Bassous (US Pat. No. 3,921,916) under 35 U.S.C. § 103(a).

In item 6 on pages 5-6 of the above-mentioned Office action, claims 5 and 7-8 have been rejected as being unpatentable over Nelson in view of Beene et al. and further in view of Givens et al. (US Pat. No. 6,080,655) under 35 U.S.C. § 103(a).

In item 7 on pages 6-7 of the above-mentioned Office action, claim 10 has been rejected as being unpatentable over Nelson in view of Beene et al. and further in view of Inoue et al. (US Pat. No. 5,270,493) under 35 U.S.C. § 103(a).

As will be explained below, it is believed that the claims were patentable over the cited art in their original form and the claims have, therefore, not been amended to overcome the references.

Before discussing the prior art in detail, it is believed that a brief review of the invention as claimed, would be helpful.

Claim 1 calls for, inter alia:

filling the through contact holes with solder material to form through contacts.

Neither Nelson nor Beene et al. show the step of "filling the through contact holes with solder material to form through contacts" as recited in claim 1 of the instant application.

The Examiner has cited column 3, lines 36-50 of Nelson as teaching filling the through contact holes with conductive material. However, this cited passage teaches, in connection with Fig. 8 for example, an electrically conductive connection 36, which connects the contact pad 22a with the through hole

30. It is clear from the top views shown, for example in Fig. 9, that Nelson teaches a conductive track 36a, which, as shown in the cross-sectional view of Fig. 8, clearly does not fill the hole 30, but provides an electrically conductive coating on the walls of the through hole. This is the feature "coating an inner wall of the through contact holes with ... a solderable surface coating," as recited in claim 1 of the instant application.

As shown in Fig. 11 and described in column 3, line 66 to column 4, line 2 as well as column 1, lines 61-63, the separated chip of Nelson which includes an electrically conducting coating on the surface of the through holes is then mounted on and electrically connected to a circuit board by solder 45. Nelson fails to disclose that the through holes are filled with solder material, i.e. that the through holes include solder material before the individual chips are separated from the wafer.

Beene et al. teach the connection of a stacked device to, for example, a substrate by placing solder on the pads 20 or on the matching grid array on the substrate (see column 3, lines 34-43). Beene et al. fail to teach a device including through holes and, therefore, also fail to teach a method in which the through holes are filled with solder material.

Also, neither Nelson nor Beene et al. provide a person skilled in the art any incentive to take the step of filling the through holes with solder material.

The inter-layer contacting methods of Nelson and Beene et al. are slow and complicated since solder is deposited on each contact point of each chip in the stack. The known methods are particularly complex for stacked chips that include interlayer contacts on four sides of the stack. In those methods, there is also the risk that solder may spread onto neighboring circuits or conducting tracks during this deposition process.

The invention of the instant application teaches an improved method of producing contacts at the edge of semiconductor chips, which enables a quicker, simplified stacking and contacting process.

The invention of the instant application teaches a method in which the through holes are filled with solder at the wafer stage. This method advantageously allows all of the through holes to be filled at the same time by, for example, capillary action, as claimed in claim 11 of the instant application. Therefore, the chips, once divided from the wafer, include a

solder filled edge contact. The stacking and electrical connection between the chips in the stack is, therefore, simplified over the methods of the prior art because the chips are simply stacked in the desired order and the solder reflowed to provide the electrical connection between the layers in the stack.

The difficulties associated with placing solder at all of the different connection points in the stack are, therefore, avoided and a simpler and quicker assembly method is provided. The method according to the invention of the instant application is particularly advantageous for stacks which include a large number of contacts, in particular, for stacks in which the through contacts of different chips connect with a conductor track or pad rather than an adjacent through hole as shown in Fig. 3 of the instant application.

The disclosure of Nelson and Beene et al. provide no reason or incentive for a person skilled in the art to provide a method, which includes the step of filling the through holes with solder material.

It is accordingly believed to be clear that none of the references, whether taken alone or in any combination, either show or suggest the features of claim 1. Claim 1 is,

therefore, believed to be patentable over the art and since all of the dependent claims are ultimately dependent on claim 1, they are believed to be patentable as well.

Applicants acknowledge the Examiner's statement in item 8 on page 7 of the above-mentioned Office action that claims 12-13 would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims.

Since claim 1 is believed to be patentable as discussed above and claims 12-13 are ultimately dependent on claim 1, they are believed to be patentable in dependent form. A rewrite is therefore believed to be unnecessary at this time.

In view of the foregoing, reconsideration and allowance of claims 1-13 are solicited.

In the event the Examiner should still find any of the claims to be unpatentable, counsel would appreciate a telephone call so that, if possible, patentable language can be worked out.

If an extension of time for this paper is required, petition for extension is herewith made. Please charge any fees which might be due with respect to 37 CFR Sections 1.16 and 1.17 to

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Respectfully submitted,

  
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